meteors in a direction parallel to the latter plane must have been twice the Earth's absolute velocity, it follows that, had the Earth stood still, the *then* apparent radiant would have had very nearly *double* that elevation (more correctly, 19° 53′), which is therefore the inclination to the Ecliptic of the meteoric orbits.

How far this conclusion of a retrograde motion of the meteorite's revolution round the Sun,—a conclusion already, I believe, arrived at by Mr. Newton, is compatible with the truth of the "Nebular hypothesis," we may leave it to the advocates of that hypothesis to consider.

I have mentioned the case of one of the meteors leaving a train visible during $2^m\ 40^s$. A much more striking instance occurred in the case of one which exploded close to the three bright stars in *Aries.* The train left at first was very bright, and very nearly parallel to the line joining $\alpha$ and $\beta$. It remained visible for no less than 6 minutes, during which time *it drifted slowly to the southwards over a space of* 8 *or* 9 *degrees, and at the same time gradually changed its direction, so that just before its disappearance it was at right angles to its original position.*

*Collingwood, Nov.* 15, 1866.

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## *Inference from the observed Movement of the Meteors in the appearance of* 1866, *November* 13–14. By G. B. Airy, Esq., Astronomer Royal.

It is established by abundant evidence that the meteors seen in the late magnificent display diverged, for the most part, with singular accuracy, from a point which may thus be described: join $\gamma$ *Leonis* and $\varepsilon$ *Leonis* by an arc of a circle, the Centre of Divergence was about a degree north of the middle of the arc. There were other centres of partial radiations, but this may be accepted as the centre of radiation of the general mass.

This was the case all through the night; in fact, the first exact determination of the point which reached me was from my son Mr. Hubert Airy, who had occasion to walk several miles between five and six o'clock in the morning of the 14th (Nov. 13, $17^h$ to $18^h$), and carefully observed a considerable number of meteors, the intersection of whose paths he determined accurately; subsequently I received the chart of Mr. Alexander Herschel, made several hours earlier, and observations of other persons at different hours; and all agreed in fixing on the point which I have specified as the centre of divergence.

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It will readily be understood that this divergence from one point is merely an effect of perspective; that the point of divergence is, in fact, the point opposite to what is usually known as the "vanishing point." It is, of course, theoretically possible to imagine an explosive point in space so changing its position as to produce effects like those which were seen; but no person, I suppose, will really maintain that explanation against the simple one, that the meteors, for the most part, retain a nearly unvaried relative position among themselves, and that the effects observed were produced by the relative movement of the Earth and the collection of meteors.

I assume here that the resistance of the air produced no remarkable change in the apparent paths of the meteors; which assumption appears to be justified by the agreement of the diverging points when far from the meridian and when near the meridian. The same agreement justifies us in thinking that the course of the meteors was not much disturbed by the Earth's attraction; a consideration, however, which in future must not be put out of sight.

I ought in strictness to have ascribed the observed effects to the relative movement of the *point of observation* and the collection of meteors; but this differs from the other by an extremely small quantity, and if the corresponding correction were applied, it would diminish the angle which I am about to mention by an insignificant fraction of a degree.

Now if the meteors had been stationary in space they would have appeared to diverge from that point in the celestial sphere towards which the Earth's motion was directed. That point is very nearly the point on the ecliptic 90° behind the Sun's apparent place, or is in longitude 141° nearly. The point of divergence did not very much differ, in longitude, from the point thus found; but it was north of the ecliptic by about 11°. It follows from this that the meteors were not stationary in space. They had not much motion towards or from the Sun; but they were moving perpendicularly to the plane of the ecliptic, from north to south, with an absolute velocity nearly $\frac{1}{5}$-part of the velocity relative to the Earth in the direction of the Earth's motion.

We have no information as to the real value of their velocity relative to the Earth in that direction, and every subsequent stage of investigation is therefore imperfect.

Let V be the velocity of the Earth in its orbit, and $v$ the velocity of the meteors in the same direction (considered as perpendicular to the Earth's radius vector) the relative velocity of the meteors in that direction was $V-v$; we may neglect the absolute velocity towards the Sun; the absolute velocity perpendicular to the plane of the ecliptic was $\frac{V-v}{5}$; the total velocity of the meteors in space was

$$\sqrt{\left\{v^2+\left(\frac{V-v}{5}\right)^2\right\}}.$$

The smallest admissible value of $v$ (in an algebraical sense) is that which makes the orbit round the Sun parabolic, supposing the meteors subject to the law of gravitation. This gives

$$v^2+\left(\frac{V-v}{5}\right)^2=2\,V^2,$$

of which the negative solution is $v=-V\times 1\cdot 32$. From this, the absolute velocity perpendicular to the ecliptic

$$=\frac{V-v}{5}=V\times 0\cdot 464;$$

and, as the meteors were then at the node, and the velocity $v$ is perpendicular to the line of nodes, the tangent of the inclination of the orbit to the ecliptic is $=\frac{0\cdot 464}{1\cdot 32}=0\cdot 35$ nearly, or the inclination is $=19^\circ\frac{1}{4}$.

The largest admissible value of $v$ is that beyond which the meteors would have been seen receding towards the vanishing point, or that which would have made them appear stationary. This gives $V-v=0$; motion towards the ecliptic $=0$; velocity parallel to the Earth's motion is $=V$; tan. inclination of orbit is $=\frac{0}{V}=0$.

We may therefore conclude that the inclination of the orbit of the meteors to the ecliptic is less than 19°.

If the absolute motion of the meteors in the direction of the Earth's movement on Nov. 13–14 was very small, the excentricity of their orbit would not be great; but in any other case it would be considerable.

*Royal Observatory, Greenwich,* 1866, *December* 10.

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## *On the Meteor Shower of* 1866, *November* 13–14.

### By Piazzi Smyth, Esq., Astronomer Royal for Scotland.

Agreeably with the important letter of Mr. A. S. Herschel, circulated by the President of the Royal Astronomical Society, meteoric shooting-stars were looked for here on the nights of the 12th and 13th instant.

On the 12th the sky was nearly covered with cloud; long,